Exhibit 5

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link between the processor and a server over which data blocks describing terrain are transferred responsive to the course, and a display on which the processor renders three-dimensional terrain images viewed from the course responsive to the data blocks.

The present invention will be more fully understood from the following detailed description of the preferred embodiments thereof, taken together with the drawings in which:

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BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic illustration of a system for displaying real-life terrain images, in accordance with a preferred embodiment of the present invention;

Fig. 2 is a schematic block diagram illustrating the data structure of images stored in a database on a pilot training server, in accordance with a preferred embodiment of the present invention;

Fig. 3 is a flow chart illustrating a method for preparation of a pilot training database, in accordance with a preferred embodiment of the present invention;

Fig. 4 is a schematic block diagram illustrating a flight course database on a pilot training server, in accordance with a preferred embodiment of the present invention;

Fig. 5 is a schematic block diagram illustrating a processor for viewing three-dimensional real-life terrain images, in accordance with a preferred embodiment of the present invention;

Fig. 6 is a flow chart illustrating the actions of the processor of Fig. 4 in displaying a selected route, in accordance with a preferred embodiment of the present invention;

Fig. 7 is a schematic view of a viewpoint and a scene viewed therefrom, useful in understanding a method of displaying the selected route, in accordance with a preferred embodiment of the present invention;

Fig. 8 is a flow chart illustrating the actions of a cache manager while the processor of Fig. 4 displays a selected route, in accordance with a preferred embodiment of the present invention; and

Fig. 9 is a schematic illustration of an image block from the data structure of Fig. 2, along with its ancestors, useful in understanding the flow chart of Fig. 8.

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DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Fig. 1 is a schematic illustration of a system 18 for displaying real-life terrain images of a flight course, in accordance with a preferred embodiment of the present invention. System 18 preferably comprises a processor 20, such as a Pentium-Pro MMX processor, and a display 22, which are used by an end-user to view 3D real-life images of terrain of desired sites. Preferably, system 18 comprises a modem 24 through which processor 20 communicates with a computerized database server 26 of 3D terrain images. Modem 24 is, for example, a standard 33,600 kb/sec modem, although other modems, faster and slower may also be employed. Alternatively, other means of connection, such as ISDN connections or direct routers, may be used instead of modem 24. Preferably, processor 20 communicates with server 26 over a public network, such as the Internet. Alternatively or additionally, processor 20 communicates with server 26 through a direct communication line. Further alternatively or additionally, processor 20 receives a storage disk 28, such as a CD, from server 26 or from any other distribution source.

Fig. 2 is a schematic illustration of the data structure of images stored in a database 40 on server 26, in accordance with a preferred embodiment of the present invention. Database 40 comprises a plurality of image blocks 42, labeled 42A, 42B, etc., which contain data representing the terrain in various areas as would be perceived from different heights. Preferably, substantially all of blocks 42 are of the same data size. Preferably, the size of the blocks is determined according to the expected rate of transmission of data via modem 24, so that a block 42 may be transmitted on the average within a predetermined amount of time, for example, half a second. In a preferred embodiment of the present invention, the blocks comprise 256x256 pixels, although the blocks may be of any other suitable

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size. Preferably, the blocks are divided into sub-blocks 43 of smaller sizes, such that processors which work with slow modems may download small sub-blocks in case the entire block is not required. In a preferred embodiment of the present invention, each block 42 is divided into sixteen sub-blocks 43 of 64x64 pixels. Each pixel is preferably represented by a color and an elevation attribute, as is known in the art. Blocks 42 are preferably real-life images of terrain areas received from airborne or satellite cameras.

Preferably, each sub-block 43 includes an attachment field in which additional optional data objects associated with the area covered by the sub-block are described. These objects preferably include, but are not limited to, labels, annotations, lines and 3D objects. Each object is preferably accompanied by coordinates which state the position of the object within sub-block 43. Preferably, the labels are stored in text format, the lines are stored as vectors, and the 3D objects are stored as polygons, although any suitable storage format may be used.

The objects may be used to represent existing structures which are not viewed sufficiently well when shown as part of the image. Alternatively or additionally, the structures may be used to overlay virtual structures on the terrain. For example, it is possible to add planned buildings to the terrain and thus see the effect of the buildings on the view. Further alternatively or additionally, the objects may be used to overlay map symbols and other markings on the terrain. The markings are preferably overlaid on the view at a constant size regardless of the resolution level of the terrain displayed.

Blocks 42 are preferably stored in database 40 in a compressed form using any suitable compression method, such as JPEG. Blocks 42 are classified in successive resolution levels 44 labeled 44A, 44B, etc., according to the height from which they view the terrain and, therefore, the level

of detail which they include. A plurality of blocks 42A which belong to the lowest resolution level 44A, labeled "level 1," cover the largest area per block and therefore have the least detail per area unit. It is noted that the size of the geographical area covered by blocks 42A of "level 1" is dependent on the specific application of database 40 and may be very diverse. For example, in some flight applications, a single block 42A includes an image of the entire Planet Earth, while in an atom-simulation application, which shows the terrain of an atom, block 42A shows the entire atom. Blocks 42B of the next level 44B, labeled "level 2," preferably cover a quarter of the area of blocks 42A of "level 1". Thus, for substantially each block 42A, there exist four blocks 42B which cover the same area. In a similar manner, each successive level 44 comprises blocks 42 which cover a quarter of the area of the blocks 42 of the lower resolution level.

Four blocks 55 of a certain level 44C, which cover the same area as a block 57 of the preceding level 44B, are referred to as descendants of block 57. Conversely, block 57 is referred to herein as the parent of blocks 55. The parent block 59 of block 57 is referred to herein as an "ancestor" of blocks 55, and is said to be of a lower resolution level than its descendants. It is noted that in Fig. 2, the lower resolution levels appear higher on the page.

Preferably, each block 42 database 40 includes pointers 52 to the four descendants of the block. If one or more of the descendants does not exist, a null pointer 56 is preferably used. Preferably, a header record 54 comprises an index to blocks 42A of "level 1" such that processor 20 can easily find the block 42A which covers a desired area.

The number of levels 44 is dependent on the images input to server 26 and may differ for different areas of terrain. Thus, one block 42A may have descendants up to level 12, for example, while another block 42A may have no descendants. It is also noted that the number of descendants

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of each block 42 may have a value different from four, for example nine, and may differ for different levels 44.

Preferably, each block 42 is referenced using longitudinal and latitudinal (x,y) coordinates of one of the points in the block, such as the top right corner pixel, together with the resolution level 44 of the block.

Fig. 3 is a flow chart illustrating a method for preparation of database 40, in accordance with a preferred embodiment of the present invention. Preferably, all the steps described in Fig. 3 are performed automatically by a processor (referred to herein as a Terra builder). The Terra Builder may prepare the images on-line provided the images are supplied at a sufficient rate. Alternatively or additionally, the Terra Builder operates together with a human operator to achieve better accuracy in the preparation of database 40.

Preferably, the Terra builder receives one or more images of a terrain area covered by the database. The images are preferably received in a standard format, such as TIFF or bitmap. The images preferably cover adjacent areas or are partially overlapping. Some of the images may cover the same area at different levels of resolution.

The processor cuts the image up into blocks 42 and assigns these blocks temporarily to the highest resolution level. Blocks of lower levels of resolution are prepared by eliminating data from the original blocks. Preferably, the blocks of lower resolution levels are prepared by decimation, for example, by eliminating odd (or even) rows and columns from the higher level blocks. Further preferably, the blocks are filtered using a low pass filter, most preferably before the decimation.

Thereafter, the blocks from different images are aligned relative to each other, based on the coordinates of the images and the meter-per-pixel resolution values of the images. Preferably, the coordinates and meter-per-pixel values are received together with the images.

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Alternatively, an operator determines and inputs the coordinate correspondences and meter-per-pixel values by viewing the images. Further alternatively or additionally, the operator inputs the heights of the terrain for some or all of the pixels.

Blocks 42 are then compressed, for example, using the JPEG compression method. The operator may add labels, lines, virtual structures and other objects, before or after the compression. Alternatively or additionally, the processor automatically derives such objects from the images. For example, the processor may identify roads and/or runways in the images and represent them as objects so that they appear more clearly in substantially any resolution of display.

It is noted that although the hierarchical structure of database 40 requires extra storage space, relative to a non-hierarchical record of the terrain, the advantages of use of the hierarchical structure justify the extra storage space required. The use of the hierarchical structure allows faster rendering of the images on display 22 and allows fast download of required images at low resolution levels. Optionally, in order to reduce storage requirements, some of blocks 42 are stored only in some of resolution levels 44, and when non-existent resolution levels are required, server 26 generates the required block from a descendant block of a higher resolution level.

Preferably, the user of processor 20 is able to add virtual structures and/or other objects to the terrain described by database 40, while viewing the terrain. Preferably, a file stored locally on processor 20 stores descriptions of the virtual structures added by the user of processor 20.

Figs. 4 is a schematic block diagram illustrating a course database 60 stored on server 26, in accordance with a preferred embodiment of the present invention. Preferably, course-database 60 includes a catalog file 62, which lists all the available routes on server 26. For each route,

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database 60 preferably includes a list 64 of three-coordinate points 66 which describe the route. The three coordinates preferably represent longitudinal, latitudinal, and height coordinates of the points along the course, as are known in the art of terrain mapping. Preferably, list 64 also includes speed settings 68, and/or other flight-relevant data.

The routes in database 60 preferably include routes terminating in landings at various airports. Using these routes, pilots may become familiar with airports to which they are scheduled to fly. Alternatively or additionally, database 60 includes routes of flight through difficult access areas, such as deep canyons in which helicopters need to fly. Further alternatively or additionally, database 60 may include routes for training military pilots in approaching a required target.

It is noted that other scenarios may be included in database 60, such as on-line images from an area of interest. For example, a route may be used to display a car race, and the points 66 describing the route may be received on-line using a GPS from one of the cars in the race. The cars are preferably superimposed on the images, using methods known in the art. A user watching the race on a home computer may select any viewpoint of interest and is not limited to pre-chosen viewpoints selected by others.

Fig. 5 is a schematic block diagram of processor 20, in accordance with a preferred embodiment of the present invention. The blocks are preferably realized as software processes running on a general-purpose microcomputer, although dedicated hardware realizations are also possible. Preferably, processor 20 comprises a navigator 70, which keeps track of a viewpoint of a virtual viewer. The viewpoint preferably follows a predetermined course which a user of processor 20 is supposed to follow. Preferably, the course is received from course database 60.

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Preferably, navigator 70 sets a default view direction of the viewpoint in the direction of movement along the course. Alternatively, the default view direction is set directly down towards the terrain. The user may change the view direction of the viewpoint without moving out of the course. Therefore, there is no compulsory correlation between the flight direction and the view direction. Preferably, the user may change the speed of motion along the course. Further preferably, the user may move the viewpoint out of the course in order to view the area around the predetermined course, or to try to find a better course. Preferably, the user controls the direction, speed, altitude and/or any other parameter of the viewpoint. Specifically, the user may freeze the viewpoint in order to have a better look at the view from a certain point or angle.

Processor 20 preferably further comprises a renderer 72, which calculates the view from the viewpoint and continuously renders the view on display 22. Renderer 72 determines the coordinates of the pixels it needs in order to render the view and requests the descriptions of these pixels from a cache manager 74. Preferably, renderer 72 determines which blocks 42 and/or sub-blocks 43 include the required pixels. Alternatively, cache manager 74 determines the identity of the required blocks 42 and/or sub-blocks 43. Along with each required pixel, block 42, or sub-block 43, renderer 72 preferably states the resolution level 44 at which the block is required. The resolution level is preferably determined based on the distance between the viewpoint and the desired pixel or block 42. Further preferably, the resolution level is also dependent on the number of pixels in the image displayed on display 22. Preferably, the resolution levels are chosen so that an approximate 1:1 ratio is achieved between the number of displayed pixels and the number of data pixels. Preferably, renderer 72 also overlays the objects associated with the rendered sub-blocks 43.

Preferably, cache manager 74 manages a group of blocks 42 and/or sub-blocks 43 in a cache memory 32 of processor 20, for example in the main memory of processor 20, in accordance with a method described hereinbelow. Alternatively or additionally, cache memory 32 is defined in a local hard disk associated with processor 20. Thus, even if processor 20 is shut down, the renderer can immediately resume operation when the processor is turned on again, at the point it left off, without downloading the data again from server 26. Further alternatively or additionally, processor 20 determines areas which are most commonly visited by the user of the processor, and blocks 42 from these areas are permanently stored in the local hard disk of processor 20. One such preferred application involves positioning processor 20 within a ground vehicle in order to view the surroundings of the vehicle. Since the vehicle is usually located in the same area, the required download time may be reduced substantially.

It is noted that the term cache memory is used herein generally to refer to any relatively small memory which can be accessed rapidly by processor 20 and is used to save data which is most likely to be used by the processor.

Cache manager 74 downloads from server 26 the blocks 42 and/or sub-blocks 43 required by renderer 72, if they are not already stored in cache memory 32, and meanwhile provides replacement blocks from the cache memory. Preferably, cache manager 74 references blocks 42 on server 26 by providing pointers to the required blocks. Cache manager 74 has the pointers for the lowest resolution level blocks 42A from header record 54. The pointer to a desired block 42 of any other level 44 is preferably taken from the parent block of the desired block, as described above. Therefore, as described hereinbelow, cache manager 74 preferably always requests that server 26 send a block 42 after the cache manager has received its parent block.

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Preferably, processor 20 establishes one or more communication connections 76 with server 26 through which blocks 42 are sent to the processor. Connections 76 are preferably standard TCP connections as are known in the art, although any other protocol may be used to form the connection. Preferably, when connections 76 are not in use bringing blocks 42 required by renderer 72, cache manager 74 downloads blocks in the area of the viewpoint to fill cache memory 32. Preferably, cache manager 74 attempts to fill cache memory 32 with a sufficient number of blocks, such that for any view direction of the current viewpoint, all blocks 42 required by renderer 72 are stored in cache memory 32. Preferably, cache manager 74 stores in cache memory 32 the same number of blocks 42 in each resolution level 44. Preferably, cache memory 32 stores, for each resolution level 44, between 9 and 36 blocks, which are most preferably organized in a square centered directly below the location of the viewpoint. In a preferred embodiment of the present invention, cache memory 32 stores sixteen blocks 42 organized in a square for each resolution level 44. Blocks 42 are preferably chosen such that the viewpoint is closest to the center of the square, most preferably, as described in the above-mentioned U.S. patent application 08/939,948.

Preferably, blocks 42 are stored in cache memory 32 in the compressed form in which they are received from server 26. Further preferably, cache manager 74 decompresses the blocks before they are provided to renderer 72. Preferably, cache manager 74 manages, in addition to cache memory 32, an open cache memory 34 in which blocks 42 and/or sub-blocks 43 which were decompressed are stored. Preferably, open cache memory 34 is of a size determined according to the amount of available empty storage space on the memory associated with processor 20 and/or the size of the image rendered on display 22. Preferably, the user of processor 20 may adjust the size of open cache memory 34 in order to achieve maximal rendering speed by saving the time required for

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decompression. In a preferred embodiment of the present invention, open cache memory 34 has a default size sufficient to store a few hundred decompressed sub-blocks 43.

Preferably, when open cache memory 34 is full, a least recently used (LRU) method is used to determine which sub-block 43 is to be discarded to make room for a new sub-block. A preferred LRU method is described in the above-mentioned 08/939,948 patent application. Alternatively or additionally, any other suitable method of memory management may be used to manage cache memory 32 and/or open cache memory 34.

Renderer 72 uses blocks 42 from cache manager 74 to render the required view on display 22. Preferably, when cache manager 74 provides a block 42 of a lower resolution level than that requested by renderer 72, the renderer uses the provided block to interpolate a higher resolution-level block. Preferably, the higher resolution-level block is interpolated using any method known in the art, such as bilinear, fractal, or texture blending.

When cache manager 74 finishes downloading an additional block of a higher resolution level from server 26, the block is provided to renderer 72, which updates the rendered view accordingly. Preferably, when the viewpoint is in motion, renderer 72 updates the view at least ten times per second so that the user has a perception of constant movement, although other rates of update may also be used. Preferably, renderer 72 renders the view each time from scratch without using previously-rendered views.

Preferably, renderer 72 is as described in the above mentioned U.S. patent application 08/939,948. Alternatively or additionally, renderer 72 may operate in accordance with any other method known in the art. Renderer 72 is preferably implemented entirely in software. Alternatively, renderer 72 includes a dedicated hardware processor, such as a 3D graphic accelerator, along with a software package running

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on general purpose processor 20 which provides blocks 42 to the dedicated hardware processor.

Fig. 6 is a flow chart showing the actions of processor 20 in selecting and displaying a flight route, in accordance with a preferred embodiment of the present invention. Preferably, when processor 20 accesses server 26 for the first time, the server sends processor 20 a software package which includes navigator 70, renderer 72 and cache manager 74. Preferably, the software package is in the form of an ActiveX plug-in sent to a network browser running on processor 20, as is known in the art. Alternatively or additionally, the user of processor 20 may receive the software package on a compact disk (CD) or on any other storage media. Preferably, the software package is stored by processor 20 so that the package need be sent only once.

Thereafter, server 26 sends catalog 62 and/or header record 54 to processor 20. The user of processor 20 chooses a desired route from catalog 62, and navigator 70 downloads the route from server 26, preferably using one or more of TCP connections 76. Navigator 70 begins to run on the downloaded route, and concurrently cache manager 74 is ordered to download one or more, preferably four, level 1 blocks 42A surrounding the starting point of the route. Thus, cache manager 74 will have in local cache memory 32 images of a very large area surrounding the starting point. Cache manager 74 can therefore provide images which cover substantially any area for which renderer 72 may request images, even if only at a low resolution level initially. Alternatively or additionally, the user may choose to begin a tour at a specific location, without referring to a specific route.

Preferably, the user is able to decide whether to display some or all of the objects associated with the database. Thus, the user may request to view only the images without any of the objects, or to see only objects which represent existing structures. Preferably, the user is able

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to request to view the images with or without labels. Thus, on a first visit to a new area, the user may view the area with labels which allow easy acquaintance with the area, while at a second visit, the user may omit the labels in order to test whether he/she has properly memorized the important labeled landmarks. Preferably, the user is able to switch between viewing the terrain with and without the objects, so that, for example, the user may easily compare the view of a desired area with and without a group of planned structures.

Fig. 7 is a schematic view of a viewpoint 80 and a scene 82 viewed therefrom, used to explain the operation of renderer 72, in accordance with a preferred embodiment of the present invention. Scene 82 includes areas 84 close to viewpoint 80, for example 1 kilometer from the viewpoint. Other areas 86 of scene 82 are far away from viewpoint 80, for example, 50-100 kilometers away. Still other areas 85 of scene 82 may be at other distances from viewpoint 80. In order to build a real life image of the view from viewpoint 80, renderer 72 needs blocks 42 from a high resolution level 44 of area 84, such that a group of buildings 88 in area 84 are seen in the image as they would be seen from 1 kilometer away. However, for area 86, renderer 72 needs only a low resolution level block 42 since a group of buildings 90 in area 86 would not be seen from viewpoint 80.

Preferably, renderer 72 determines the exact blocks needed and calls for them using their (x,y) coordinates and their resolution level 44. Alternatively or additionally, renderer 72 specifies, for each resolution level 44, the coordinates of the boundaries of the necessary areas, and cache manager 74 determines the identities of the required blocks 42. Preferably, when only a small part of a block 42 is required, cache manager 74 orders only the required sub-blocks 43 in order to save transmission time. On the average, rendering a view image requires between about 20 and 200 sub-blocks 43 of various resolution levels 44.

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Fig. 8 is a flow chart illustrating the actions of cache manager 74 in displaying a selected route by processor 20, in accordance with a preferred embodiment of the present invention. After downloading the first batch of level 1 blocks, as indicated in block 102, cache manager 74 moves into a wait state, as indicated by block 100.

Reference is also made to Fig. 9, which is a schematic illustration of a block 150 (corresponding either to one of blocks 42 or one of sub-blocks 43) requested by renderer 72, and ancestors 152, 154 and 158 of the requested block. When a request for block 150, identified as "x," and having resolution level N, is received from renderer 72, cache manager 74 determines, as indicated in block 104 (Fig. 8), the level j of the highest resolution-level ancestor of block x stored in cache memory 32. If the block 42 itself is stored in cache memory 32 (i.e., j=N), the block is provided to renderer 72. Otherwise, the highest resolution level ancestor 152 of block x which is stored in cache memory 32 is provided to renderer 72, as indicated in block 106. As described hereinbelow, cache manager 74 downloads the rest of the ancestors 158 of block x from server 26 in order of increasing resolution levels, as indicated by an arrow 156 in Fig. 9. As the blocks are received from the server, they are supplied to renderer 72 so that the user sees an image whose resolution increases with time.

Thus, if viewpoint 80 is not changed, or is changed relatively slowly, the resolution level of the images displayed by renderer 72 is slowly increased until the maximal desired resolution is reached. Naturally, if database 40 does not includes blocks at a desired level of resolution for a certain area, the last block supplied is of the highest existing level of resolution for that certain area.

If no ancestor of block x is found in memory 32 (an eventuality not shown in the figure), the level 1 ancestor 154 of the block is ordered from server 26, based on the

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pointer to the level 1 ancestor block in header record 54. While waiting for the ordered block, renderer 72 preferably renders a blank block to the display. Alternatively, renderer 72 waits until level 1 ancestor 154 is received. However, it is noted that such cases are very rare, since blocks 42A of level 1 cover very large areas, and usually, blocks 42A adjacent to the block in use are also downloaded and stored in cache memory 32.

If block x itself was not found in memory 32, cache manager 74 adds to a download queue the block x and all its ancestors 158 of resolution levels higher than level j, as indicated by block 108. If all TCP connections 76 available to processor 20 are in use, cache manager 74 returns to wait state 100 until one of connections 76 is available. If one of connections 76 is available the newly added blocks to the queue are immediately ordered. Preferably, cache manager 74 proceeds to send a download order to server 26 for the lowest resolution-level block in the download queue, as indicated by blocks 112, 114, 116 and 118. Alternatively or additionally, the download queue is managed by server 26.

Preferably, if more than one block of the lowest resolution level is in the queue, the last entered block is downloaded (so long as the block is still within range, as described hereinbelow). The downloaded block is thereafter removed from the queue, either when the download order is sent as indicated in block 120, or when the block has been completely received. Cache manager 74 preferably moves back to wait state 100 to wait for the completion of the downloading of the block.

Preferably, before a download order for block x is sent to server 26, cache manager 74 checks whether the block is still needed, as indicated by block 116. Most preferably, cache manager 74 checks whether the block is within a range of the current viewpoint such that it would meet the criteria for the cache manager to order it for download to cache memory 32. If block x is not within the range of the

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current viewpoint, the block is not useful for the renderer and is therefore not downloaded. This situation may occur when the viewpoint has changed substantially since block x was put into the download queue. Alternatively or additionally, cache manager 74 scans the download queue periodically for block orders which are not currently useful and must be erased from the queue.

When one of TCP connections 76 notifies cache manager 74 that the transfer of a block Y has been completed, the cache manager 74 checks whether the block is currently needed by renderer 72, as indicated by block 122. Preferably, cache manager 74 queries renderer 72 regarding each received block as to whether the renderer currently needs the block. Alternatively or additionally, cache manager 74 maintains a list of blocks for which download orders were sent, and therefore are needed by renderer 72. Preferably, renderer 72 notifies cache manager 74 of blocks it requested and did not receive which it does not need any more. Alternatively, each order from renderer 72 to cache manager 74 includes all the blocks it needs, and blocks not in the order are not needed any more by the renderer.

If renderer 72 needs the downloaded block (i.e., it was not ordered solely to fill cache memory 32, as described hereinbelow), it is passed to the renderer, as indicated by block 124. Preferably, all the received blocks are stored in cache memory 32 for later use, as indicated by block 126. If cache memory 32 is full, a block beyond the predetermined range from the current viewpoint is discarded, as indicated by block 128. Preferably, the discarded block is the least recently used block which is beyond the predetermined range. Alternatively, the discarded block is chosen from the highest resolution level for which there are blocks beyond the predetermined range.

After downloading of a block has been completed, one of connections 76 is necessarily not in use. If the download queue is not empty, a block from the queue is downloaded as

described hereinabove and indicated in blocks 112, 114, 116 and 118. However, if the queue is empty, cache manager 74 fills cache memory 32 with the blocks within the range of the current viewpoint, so that, for any direction of view from the current viewpoint, there is no need to download further blocks from server 26.

Preferably, the next block downloaded for filling cache memory 32 is from the lowest resolution level for which all the blocks in the range of the viewpoint are not already in the cache memory, as indicated in block 130. Further preferably, cache manager 74 first downloads the eight blocks surrounding the block which is directly below the current viewpoint. Alternatively or additionally, the blocks are ordered according to the current view direction of the viewpoint.

It will be appreciated that although the above-described preferred embodiment relates to pilot training, other uses of displaying three dimensional terrain images are included in the scope of the present invention. Such uses include, but are not limited to, display of terrain for purposes of real estate trading, travel, education and amusement uses, in which the terrain may be shown at various levels of detail. Furthermore, the terrain is not limited to the Earth or parts thereof, and may cover other planets (real or virtual) and/or 3D views of surfaces of real or imaginary objects, such as views showing the atomic structure of a material, and the like. In addition, the data streaming methods of the present invention may be used to convey large databases of data which are to be displayed graphically, such as in graphic displays of stock values.

It will be appreciated that the preferred embodiments described above are cited by way of example, and the full scope of the invention is limited only by the claims.

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CLAIMS

~~1. A method of providing data blocks describing three-dimensional terrain to a renderer, the data blocks belonging to a hierarchical structure which includes blocks at a plurality of different resolution levels, the method comprising:~~

~~receiving from the renderer one or more coordinates in the terrain along with indication of a respective resolution level;~~

~~providing the renderer with a first data block which includes data corresponding to the one or more coordinates, from a local memory; and~~

~~downloading from a remote server one or more additional data blocks which include data corresponding to the one or more coordinates if the provided block from the local memory is not at the indicated resolution level.~~

~~2. A method according to claim 1, wherein providing the first data block comprises providing the data block from the highest resolution level which includes data corresponding to the one or more coordinates.~~

~~3. A method according to claim 1, wherein downloading the one or more additional data blocks comprises downloading a block at a resolution level higher than the resolution level of the first block.~~

Sub C1

2 ~~4~~. A method according to claim 1 ~~3~~, wherein downloading the one or more additional data blocks comprises downloading the blocks from a succession of resolution levels, from the level immediately higher than the resolution level of the first block up to the maximal existent resolution level on the server not above the indicated resolution level.

~~5. A method according to claim 1, wherein receiving from the renderer the one or more coordinates comprises receiving a plurality of coordinates included in a plurality of respective distinct blocks, and wherein downloading the one~~

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or more blocks comprises downloading blocks including data corresponding to at least some of the plurality of coordinates.

6. A method according to claim 5, wherein downloading the blocks comprises downloading the blocks in an order determined according to their resolution levels.

Sub C2

7. A method according to claim 6, wherein downloading the blocks comprises downloading blocks of lower resolution levels before blocks of higher resolution levels.

8. A method according to claim 7, wherein downloading the blocks comprises downloading first the block for which the coordinates were provided last among blocks at a common resolution level.

9. A method according to claim 5, wherein downloading the blocks comprises downloading the blocks according to the order in which the coordinates were provided.

6 ~~10~~. A method according to claim 5 ~~9~~, wherein downloading the blocks comprises downloading first the block for which the coordinates were provided last.

Sub C3

11. A method according to claim 1, and comprising downloading excess blocks not currently needed by the renderer to fill up the local memory when not downloading blocks required by the renderer.

9. ~~12.~~ A method according to claim 7 ~~11~~, wherein the renderer renders a view from a current viewpoint, and wherein downloading the excess blocks comprises filling the local memory with substantially all of the blocks surrounding a point in the terrain seen from the current viewpoint within a predetermined distance range.

10. ~~13.~~ A method according to claim 9 ~~12~~, wherein downloading excess blocks comprises filling the local memory with substantially the same number of blocks from each different resolution level.

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11. ~~14~~. A method according to claim 9 ~~12~~, wherein filling the local memory comprises filling the memory with substantially all the blocks within the range from a lower resolution level before downloading blocks of higher resolution levels.

Sub C2

~~15. A method according to claim 1, wherein downloading the data blocks comprises downloading the blocks via the Internet.~~

16. A method of displaying three dimensional images, comprising:

establishing a communication link between a local processor and a server;

transferring data blocks describing terrain over the communication link from the server to the local processor; and

rendering a three-dimensional terrain image at the local processor responsive to the data blocks.

17. A method according to claim 16, wherein establishing the communication link comprises establishing a low-speed communication link.

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18. A method according to claim 16, wherein transferring the data blocks comprises transferring the blocks via the Internet.

19. A method according to claim 16, wherein transferring the data blocks comprises transferring the blocks responsive to a list of coordinates generated by the processor.

20. A method according to claim 19, wherein the list of coordinates is prepared responsive to a viewpoint from which the image is rendered.

21. A method according to claim 20, wherein the viewpoint changes over time following a predetermined course.

22. A method according to claim 21, wherein the predetermined course is received from the server.

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23. A method according to claim 21, wherein the predetermined course describes a suggested course for landing in an airport.

24. A method according to claim 21, wherein a user of the processor changes the view direction from the viewpoint without removing the viewpoint from the predetermined course.

25. A method according to claim 20, wherein the viewpoint is controlled by a user of the processor.

26. A method according to claim 16, wherein transferring the data blocks comprises transferring blocks which include altitude data of the terrain.

27. A method according to claim 16, wherein transferring the data blocks comprises transferring blocks which include objects to be overlaid on the terrain.

28. A method according to claim ~~27~~ 16, wherein rendering the images comprises rendering images including representations of at least some of the objects overlaid on the terrain according to settings made by the user of the local processor.

29. A method of pilot training, comprising:

loading a course of a flight vehicle into a local processor;

establishing a communication link between the processor and a server;

transferring data blocks describing terrain viewed from the course over the communication link from the server to the local processor; and

rendering a three-dimensional terrain image at the local processor responsive to the data blocks.

30. A method according to claim 29, wherein the course describes a suggested course for landing in an airport.

32837S6

31. Apparatus for providing data blocks describing three-dimensional terrain to a renderer, the data blocks belonging to a hierarchical structure which includes blocks at a plurality of different resolution levels, the apparatus comprising:

a local memory, which stores data blocks corresponding to coordinates proximal to a current viewpoint of the renderer;

a communication link, through which the memory receives the data blocks from a remote server; and

a processor which receives one or more specified coordinates along with indication of a respective resolution level from the renderer, provides the renderer with a first data block which includes data corresponding to the one or more specified coordinates from the local memory, and downloads over the communication link one or more additional data blocks which include data corresponding to the one or more coordinates if the first block is not from the indicated level.

32. Apparatus according to claim 31, wherein the processor provides the first data block from the highest resolution level which includes the one or more coordinates currently available in the local memory.

Sub C4

33. Apparatus according to claim 31, wherein the processor downloads a block of a resolution level higher than the resolution level of the first block.

34. Apparatus according to claim 31, wherein the processor downloads blocks from the resolution level immediately higher than the resolution level of the first block up to a maximal resolution level of blocks stored on the server that is not above the indicated resolution level.

35. ~~Apparatus~~ according to claim 31, wherein the processor receives from the renderer a plurality of coordinates included in a plurality of respective distinct blocks and

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downloads blocks including at least some of the plurality of coordinates.

36. Apparatus according to claim 35, wherein the processor downloads the blocks in an order determined according to their resolution levels.

Sub 05

37. Apparatus according to claim 36, wherein the processor downloads blocks of lower resolution levels before blocks of higher resolution levels.

38. Apparatus according to claim 37, wherein the processor downloads in first precedence the block for which the coordinates were provided last among blocks from a common resolution level.

39. Apparatus according to claim 35, wherein the processor downloads the blocks according to the order in which the coordinates were provided.

17. ~~40.~~ Apparatus according to claim 16 ~~39,~~ wherein the processor downloads in first precedence the block for which the coordinates were provided last.

Sub C6

41. Apparatus according to claim 31, wherein the processor downloads excess blocks not currently needed by the renderer to fill up the local memory when the processor is not downloading blocks required by the renderer.

19 ~~42.~~ Apparatus according to claim 18 ~~41,~~ wherein the renderer renders a view from a current viewpoint and the processor fills the local memory with substantially all the blocks surrounding a point in the terrain seen from the current viewpoint in a predetermined range.

20. ~~43.~~ Apparatus according to claim 19 ~~42,~~ wherein the processor fills the local memory with substantially the same number of blocks from each resolution level.

21. ~~44.~~ Apparatus according to claim 19 ~~42,~~ wherein the processor fills the local memory with substantially all the blocks

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from a lower level before downloading blocks of higher resolution levels.

Sub C4

45. Apparatus according to claim 31, wherein the communication link comprises a connection to the Internet.

46. Apparatus for displaying three dimensional images, comprising:

a processor;

a communication link between the processor and a server over which data blocks describing terrain are transferred; and

a display on which the processor renders three-dimensional terrain images responsive to the data blocks.

47. Apparatus according to claim 46, wherein the communication link comprises a low-speed communication link.

48. Apparatus according to claim 46, wherein the data blocks are transferred responsive to a list of coordinates from the processor.

49. Apparatus according to claim 48, wherein the list of coordinates is prepared responsive to a viewpoint from which the image is perceived.

B

50. Apparatus according to claim 49, wherein the viewpoint follows a predetermined course.

51. Apparatus according to claim 50, wherein the predetermined course is received from the server.

52. Apparatus according to claim 50, wherein the predetermined course describes a suggested course for landing in an airport.

53. Apparatus according to claim 50, wherein a user of the processor may change the view direction from the viewpoint without moving the viewpoint from the predetermined course.

54. Apparatus according to claim 49, wherein the viewpoint is controlled by a user of the processor.

39

32837S6

55. Apparatus according to claim 46, wherein the communication link comprises a connection to the Internet.

56. Pilot training apparatus, comprising:

a processor which tracks a predetermined course of a flight vehicle;

a communication link between the processor and a server over which data blocks describing terrain are transferred responsive to the course; and

a display on which the processor renders three-dimensional terrain images viewed from the course responsive to the data blocks.

add B1

BY EXPR MAIL NO. EL151574859US

Atty Docket No. SANF-22100 USA

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

REMOTE LANDSCAPE DISPLAY AND PILOT TRAINING

the specification of which (check one) X is attached hereto or ___ was filed on ___ as Application no. ___ and was amended on ___ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose all information which is material to patentability as defined in 37 CFR § 1.56.

09525833.022299

I hereby claim foreign priority benefits under 35 U.S.C. § 119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed Yes	Priority Claimed No
Number	Country	Day/Month/Year Filed	___	___
Number	Country	Day/Month/Year Filed	___	___

I hereby claim the benefit under 35 U.S.C. § 119(e) of any United States provisional application(s) below.

Application Number	Filing Date
Application Number	Filing Date

I hereby claim the benefit under 35 U.S.C. § 120 of any United States application(s), or § 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of 35 U.S.C. § 112, I acknowledge the duty to disclose all information which is material to patentability as defined in 37 CFR § 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application:

Application Number	Filing Date	Status: Patented, Pending, Abandoned
Application Number	Filing Date	Status: Patented, Pending, Abandoned

I HEREBY APPOINT THE FOLLOWING AS MY ATTORNEYS WITH FULL POWER OF SUBSTITUTION TO PROSECUTE THIS APPLICATION AND TRANSACT ALL BUSINESS IN THE PATENT OFFICE CONNECTED THEREWITH:

Karl A. Limbach	18,689	Mark A. Dalla Valle	34,147	Kyle L. Herriel	41,816
George C. Limbach	19,305	Charles P. Sammut	28,901	Mayumi Maeda	40,075
John K. Uilkema	20,282	Mark C. Pickering	36,239	Kent J. Tobin	39,494
Neil A. Smith	25,441	Patricia Coleman James	37,155	Michael R. Ward	38,651
Veronica C. Devitt	29,375	Kathleen A. Frost	37,326	Steven M. Santisi	40,157
Ronald L. Yin	27,607	Alan S. Hodes	38,185	Charles L. Hamilton	42,624
Gerald T. Sekimura	30,103	Alan A. Limbach	39,749	Andrew V. Smith	43,132
Michael A. Stallman	29,444	Douglas C. Limbach	35,249	Heath W. Hoglund	41,076
Philip A. Girard	28,848	Brian J. Keating	39,520	William G. Goldman	42,590
Michael J. Pollock	29,098	Seong-Kun Oh*		J. Thomas McCarthy	22,420
Stephen M. Everett	30,050	Cameron A. King	41,897	Joel G. Ackerman	24,307
Alfred A. Equitz	30,922				

* Recognition under 37 CFR 10.9(b)

Send correspondence to

Limbach & Limbach L.L.P.
Attn: ______________
2001 Ferry Building
San Francisco, CA 94111
Telephone: 415/433-4150

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both, under 18 U.S.C. § 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or first inventor Ronnie Yaron

Inventor's signature X [signature] X Feb 2nd 1999
Date

Residence Kadima, Israel

Citizenship Israel

Post Office Address 3/6 Anafa Street, Kadima, Israel

Full name of second joint inventor, if any, Ofer Shor

Inventor's signature X [signature] X Feb 2nd 1999
Date

Residence Tel Aviv, Israel

Citizenship Israel

Post Office Address 29 Ifrah Street, Tel Aviv 67945, Israel

Full name of third joint inventor, if any, ______________

Inventor's signature ______________
Date

Residence ______________

Citizenship ______________

Post Office Address ______________

BY EXPRESS MAIL NO. EL151574859US

Applicant or Patentee: ____________ Attorney's SANF-
Serial or Patent No.: ____________ Docket No.22100USA
Filed or Issued: ____________
For: ____________

VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY STATUS
(37 CFR 1.9(f) and 1.27(c)) - SMALL BUSINESS CONCERN

I hereby declare that I am

X [ ] the owner of the small business concern identified below:
[X] an official of the small business concern empowered to act on behalf of the concern identified below:

NAME OF CONCERN SKYLINE SOFTWARE SYSTEMS LTD.
ADDRESS OF CONCERN 13 Gush Etzion Street, Givat Shmuel 54030, Israel

I hereby declare that the above identified small business concern qualifies as a small business concern as defined in 13 CFR 121.3-18, and reproduced in 37 CFR 1.9(d), for purposes of paying reduced fees under section 41(a) and (b) of Title 35, United States Code, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both.

I hereby declare that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention, entitled REMOTE LANDSCAPE DISPLAY AND PILOT TRAINING by inventor(s) Ronnie Yaron & Ofer Shor described in

[X] the specification filed herewith
[ ] application serial no. ____________, filed ____________.
[ ] patent no. ____________, issued ____________.

If the rights held by the above identified small business concern are not exclusive, each individual, concern or organization having rights to the invention is listed below* and no rights to the invention are held by any person, other than the inventor, who could not qualify as a small business concern under 37 CFR 1.9(d) or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e). *NOTE: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27)

NAME ____________
ADDRESS ____________
[ ] INDIVIDUAL [ ] SMALL BUSINESS CONCERN [ ] NONPROFIT ORGANIZATION

NAME ____________
ADDRESS ____________
[ ] INDIVIDUAL [ ] SMALL BUSINESS CONCERN [ ] NONPROFIT ORGANIZATION

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

NAME OF PERSON SIGNING X RONNIE YARON
TITLE OF PERSON OTHER THAN OWNER X VICE PRESIDENT
ADDRESS OF PERSON SIGNING X 3/6 ANAFA ST KADIMA, ISRAEL

SIGNATURE X [signature] DATE X Feb 2nd 1999

1 OF 9

PRINT OF DRAWINGS
AS ORIGINALLY F
POWELL

2772

345/419

09985220 . 022699

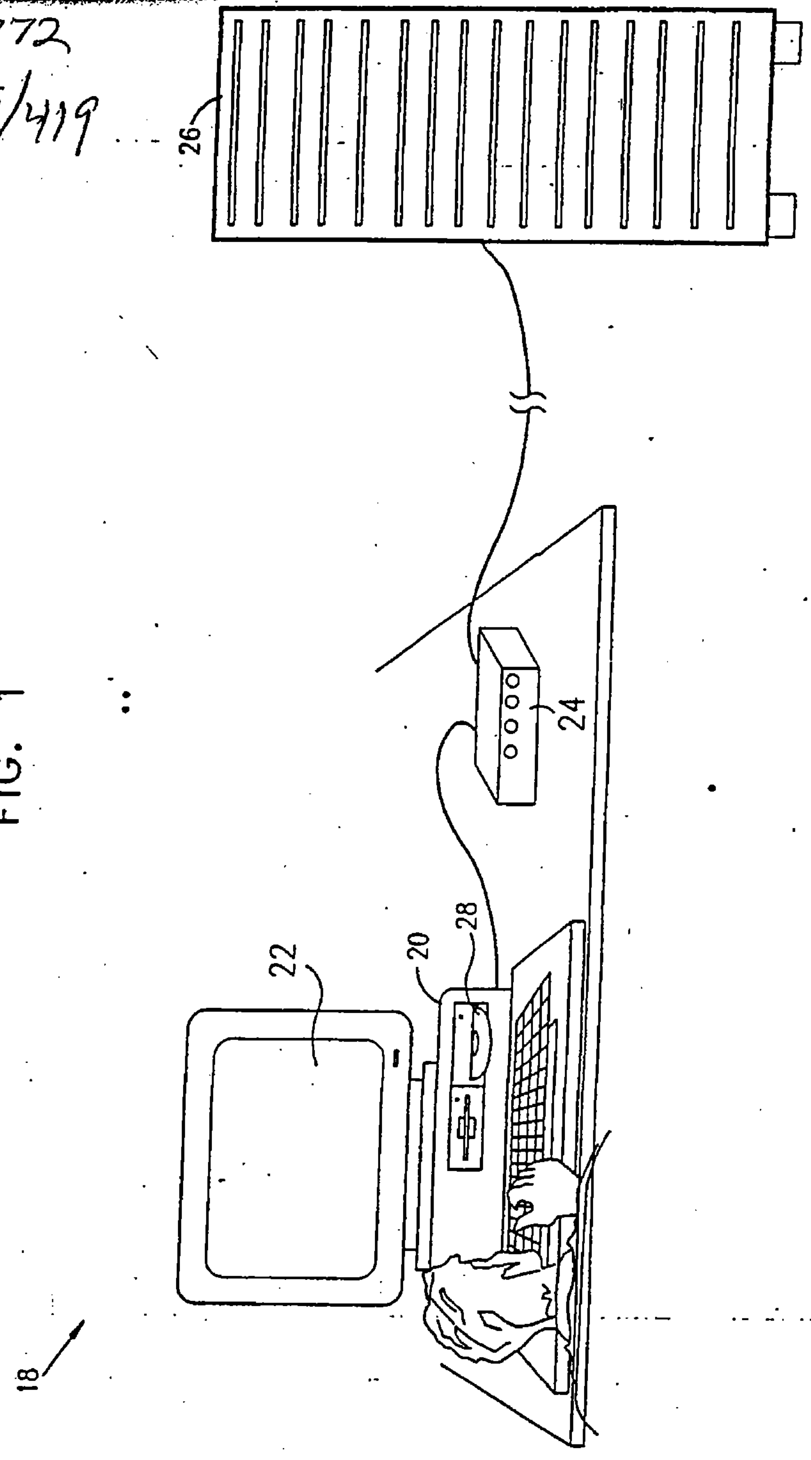


FIG. 1

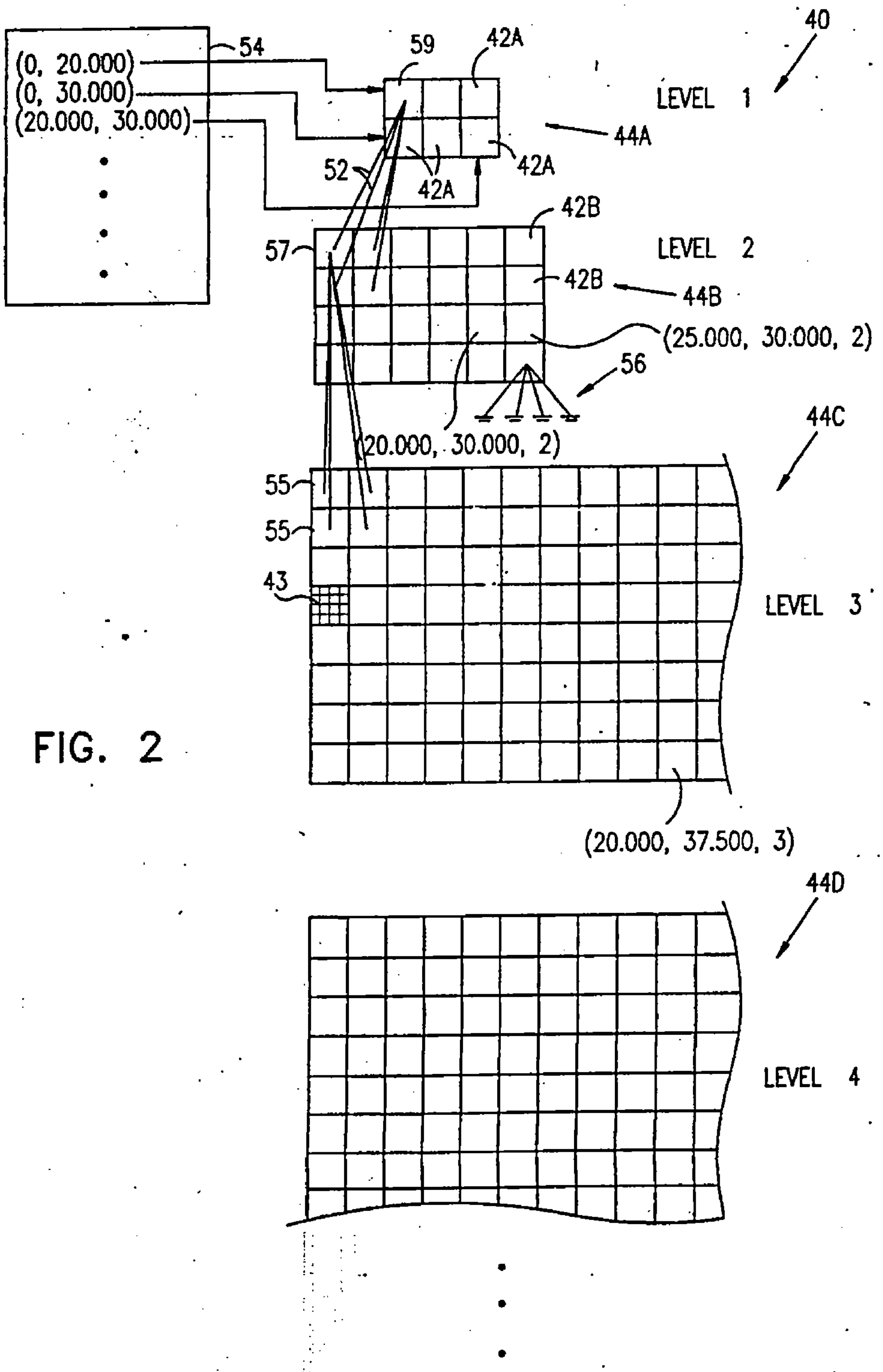

(0, 20.000)
(0, 30.000)
(20.000, 30.000)
54
59
42A
40
LEVEL 1
44A
52
42A
42A
42B
57
LEVEL 2
42B
44B
(25.000, 30.000, 2)
56
(20.000, 30.000, 2)
44C
55
55
43
LEVEL 3
(20.000, 37.500, 3)
44D
LEVEL 4

FIG. 2

FIG. 3

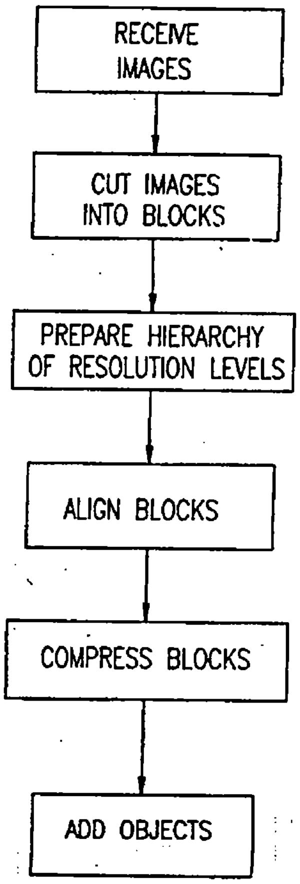
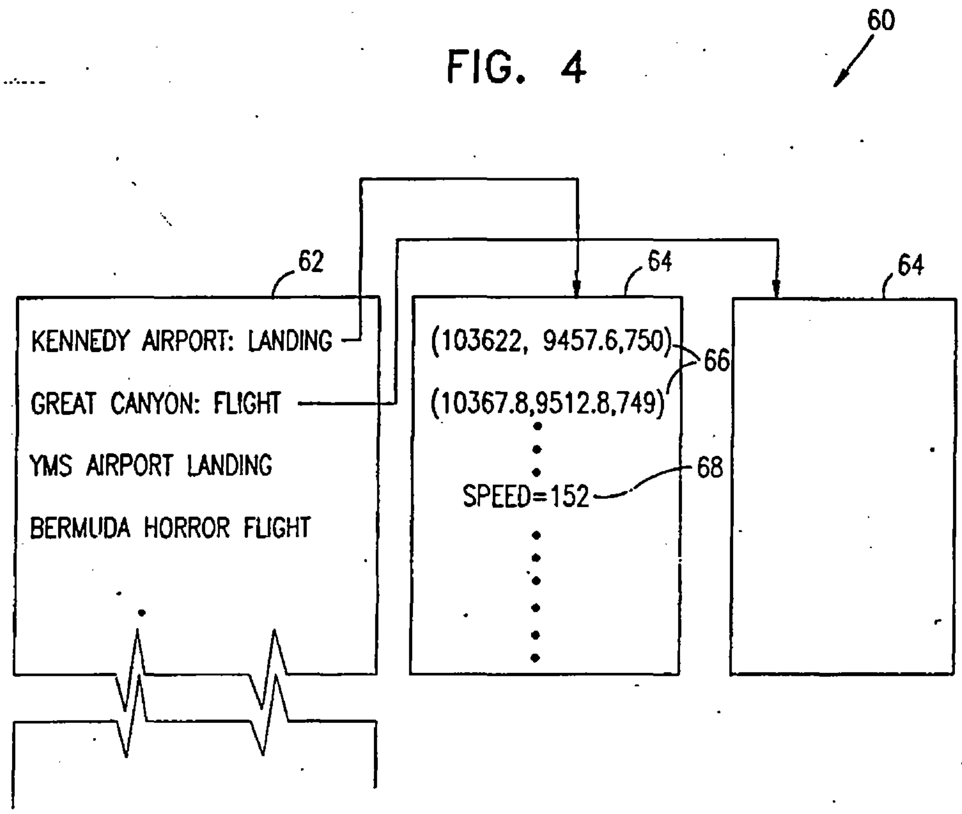

RECEIVE IMAGES
CUT IMAGES INTO BLOCKS
PREPARE HIERARCHY OF RESOLUTION LEVELS
ALIGN BLOCKS
COMPRESS BLOCKS
ADD OBJECTS

FIG. 4


60
62
KENNEDY AIRPORT: LANDING
GREAT CANYON: FLIGHT
YMS AIRPORT LANDING
BERMUDA HORROR FLIGHT
64
(103622, 9457.6,750)
(10367.8,9512.8,749)
66
SPEED=152
68
64

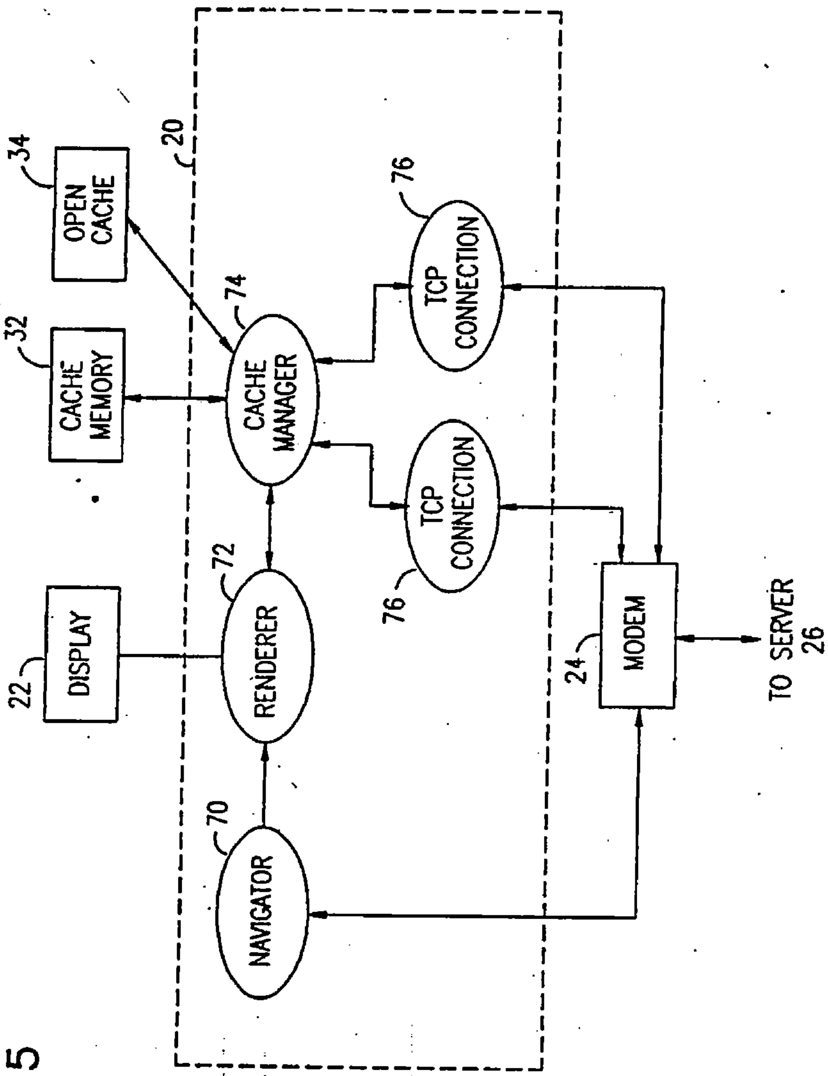

OPEN CACHE
34
CACHE MEMORY
32
DISPLAY
22
20
CACHE MANAGER
74
RENDERER
72
NAVIGATOR
70
TCP CONNECTION
76
TCP CONNECTION
76
MODEM
24
TO SERVER 26

FIG. 5

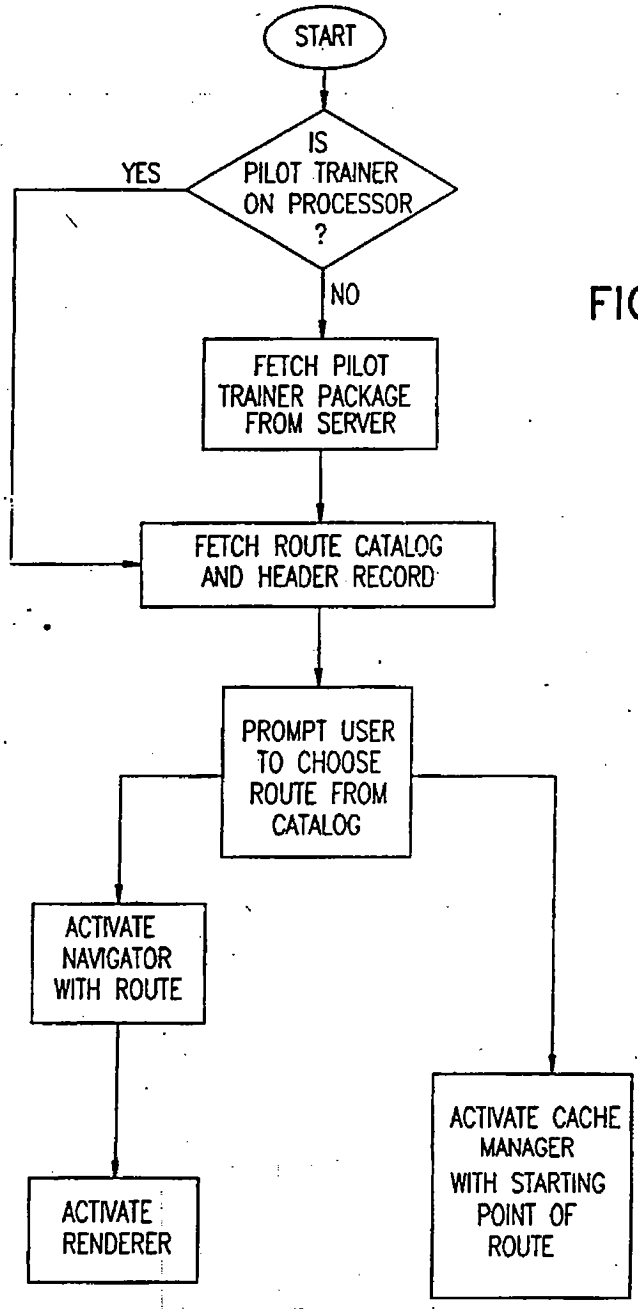

START
IS PILOT TRAINER ON PROCESSOR ?
YES
NO
FETCH PILOT TRAINER PACKAGE FROM SERVER
FETCH ROUTE CATALOG AND HEADER RECORD
PROMPT USER TO CHOOSE ROUTE FROM CATALOG
ACTIVATE NAVIGATOR WITH ROUTE
ACTIVATE RENDERER
ACTIVATE CACHE MANAGER WITH STARTING POINT OF ROUTE

FIG. 6

FIG. 7

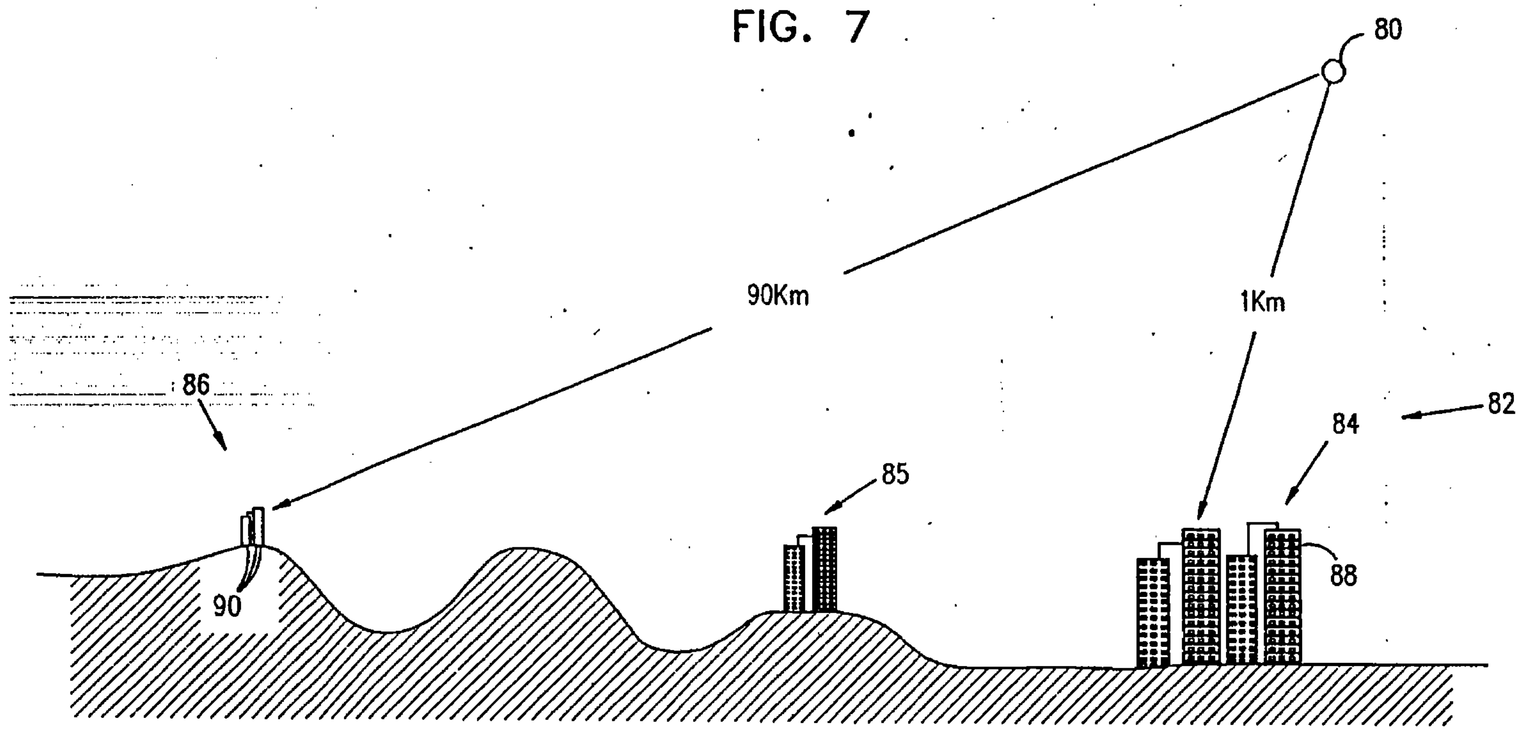
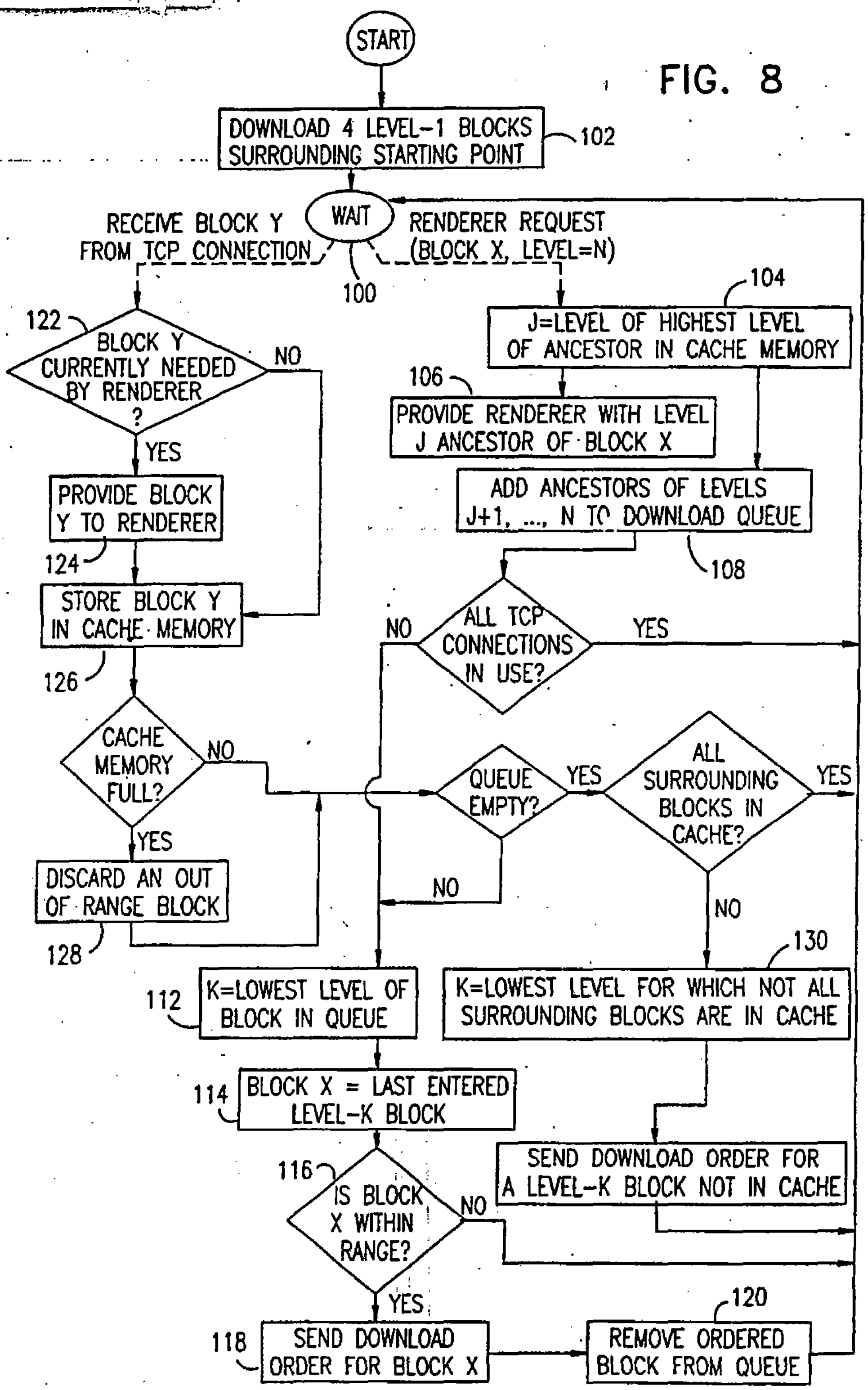


FIG. 8


START
DOWNLOAD 4 LEVEL-1 BLOCKS SURROUNDING STARTING POINT
102
WAIT
100
RECEIVE BLOCK Y FROM TCP CONNECTION
RENDERER REQUEST (BLOCK X, LEVEL=N)
104
J=LEVEL OF HIGHEST LEVEL OF ANCESTOR IN CACHE MEMORY
106
PROVIDE RENDERER WITH LEVEL J ANCESTOR OF BLOCK X
ADD ANCESTORS OF LEVELS J+1, ..., N TO DOWNLOAD QUEUE
108
122
BLOCK Y CURRENTLY NEEDED BY RENDERER ?
NO
YES
PROVIDE BLOCK Y TO RENDERER
124
STORE BLOCK Y IN CACHE MEMORY
126
CACHE MEMORY FULL?
NO
YES
DISCARD AN OUT OF RANGE BLOCK
128
ALL TCP CONNECTIONS IN USE?
NO
YES
QUEUE EMPTY?
YES
NO
ALL SURROUNDING BLOCKS IN CACHE?
YES
NO
130
112
K=LOWEST LEVEL OF BLOCK IN QUEUE
K=LOWEST LEVEL FOR WHICH NOT ALL SURROUNDING BLOCKS ARE IN CACHE
114
BLOCK X = LAST ENTERED LEVEL-K BLOCK
SEND DOWNLOAD ORDER FOR A LEVEL-K BLOCK NOT IN CACHE
116
IS BLOCK X WITHIN RANGE?
NO
YES
118
SEND DOWNLOAD ORDER FOR BLOCK X
120
REMOVE ORDERED BLOCK FROM QUEUE

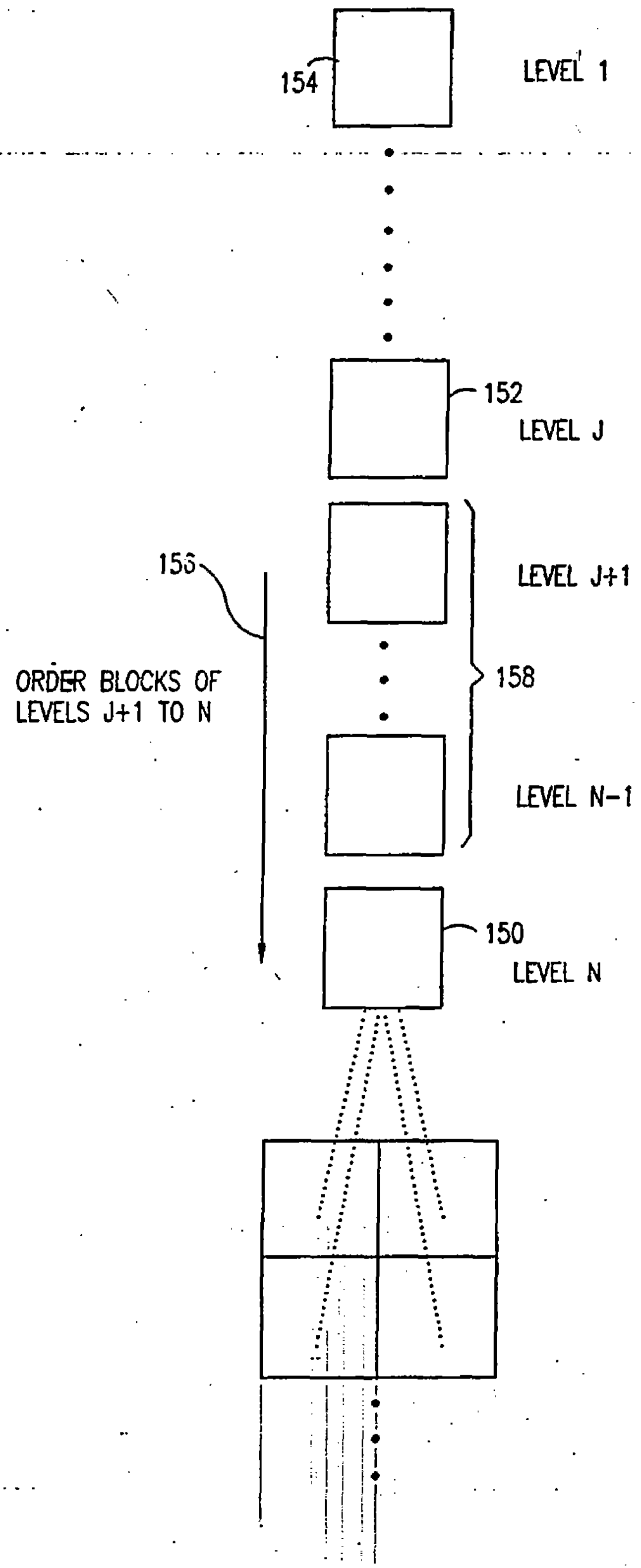

154
LEVEL 1
152
LEVEL J
LEVEL J+1
156
ORDER BLOCKS OF
LEVELS J+1 TO N
158
LEVEL N-1
150
LEVEL N

FIG. 9

LIMBACH & LIMBACH L.L.P.
2001 Ferry Building, San Francisco, CA 94111
415/433-4150

Address to:
Box Patent Application
Assistant Commissioner for Patents
Washington, D.C. 20231

Attorney's Docket No. SANF-22100-USA
[32837]
First Named Inventor RONNIE YARON

UTILITY PATENT APPLICATION TRANSMITTAL
(under 37 CFR 1.53(b))

JC518 U.S. PTO
09/258663
02/26/99

SIR:

Transmitted herewith for filing is the patent application entitled:
REMOTE LANDSCAPE DISPLAY AND PILOT TRAINING

CERTIFICATION UNDER 37 CFR § 1.10

I hereby certify that this New Application and the documents referred to as enclosed herein are being deposited with the United States Postal Service on this date February 26, 1999, in an envelope bearing "Express Mail Post Office To Addressee" Mailing Label Number EL151574859US addressed to: Box Patent Application, Assistant Commissioner for Patents, Washington, D.C. 20231.

Howard Wong
(Name of person mailing paper) (Signature)

Enclosed are:

1. X Transmittal Form (two copies required)

2. The papers required for filing date under CFR § 1.53(b):
   i. 39 Pages of specification (including claims and abstract);
   ii. 9 Sheets of drawings.
   x formal __ Informal

3. Declaration or oath
   a. x Newly executed (original or copy)

4. __ Microfiche Computer Program (Appendix, see 37 CFR 1.96)

5. __ Nucleotide and/or Amino Acid Sequence Submission (if applicable, all necessary)
   i. __ Computer Readable Copy
   ii. __ Paper Copy (identical to computer copy)
   iii. __ Pursuant to 37 C.F.R. §1.821(g), the undersigned has reviewed the paper copy and the computer readable copy of the Sequence Listing and determined the information recorded in computer readable form is identical to the written Sequence Listing.

ACCOMPANYING APPLICATION PARTS

6. x An assignment of the invention to SKYLINE SOFTWARE SYSTEMS, LTD. is attached (including Form PTO-1595).
   i. __ 37 CFR 3.73(b) Statement (when there is an assignee)

7. x Power of Attorney

8. __ An Information Disclosure Statement (IDS) is enclosed, including a PTO-1449 and copies of __ references.

9. __ Preliminary Amendment.

10. X Return Receipt Postcard (MPEP 503 -- should be specifically itemized)

11. FOREIGN PRIORITY
   [] Priority of application no. _ filed on _ in _ is claimed under 35 USC 119.
   The certified copy of the priority application:
   _ is filed herewith; or
   _ has been filed in prior application no. _ filed on _, or
   _ will be provided.

Rev. 11/17/98

__ English Translation Document (if applicable)

12. FEE CALCULATION
a. __ Amendment changing number of claims or deleting multiple dependencies is enclosed.

CLAIMS AS FILED

	Number Filed	Number Extra	Rate	Basic Fee ($760)
Total Claims	56 - 20	* 36	x $18.00	648.00
Independent Claims	6 - 3	* 3	x $78.00	234.00
__ Multiple dependent claim(s), if any			$260.00	0

*If less than zero, enter "0".

Filing Fee Calculation $1,642.00

50% Filing Fee Reduction (if applicable) $821.00

13. Small Entity Status
a. x A small entity statement is enclosed.
b. __ A small entity statement was filed in the prior nonprovisional application and such status is still proper and desired.
c. __ is no longer claimed.

14. Other Fees
x Recording Assignment [$40.00] $40.00
__ Other fees
Specify ____________ $861.00

Total Fees Enclosed $861.00

15. Payment of Fees
x Check(s) in the amount of $ 861.00 enclosed.
__ Charge Account No. 12-1420 in the amount of $__.
A duplicate of this transmittal is attached.

16. All correspondence regarding this application should be forwarded to the undersigned attorney:

Stephen M. Everett
Limbach & Limbach L.L.P.
2001 Ferry Building
San Francisco, CA 94111
Telephone: 415/433-4150
Facsimile: 415/433-8716

17. Authorization to Charge Additional Fees
X The Commissioner is hereby authorized to charge any additional fees (or credit any overpayment) associated with this communication and which may be required under 37 CFR § 1.16 or § 1.17 to Account No. 12-1420. A duplicate of this transmittal is attached.

LIMBACH & LIMBACH L.L.P.

Feb. 26, 1999
(Date)

By: [signature]
Stephen M. Everett
Registration No. 30,050
Attorney(s) or Agent(s) of Record

Attorney Docket No. SANF-22100-USA
[32837]